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ABSTRACT

This chapter presents and analyzes current developments in the evolution of the instructional development model. First, basic definitions of general systems and instructional development model terms are provided, and the differing uses of the terms instructional development, instructional technology, and educational technology are considered. The idea of a model and four different ways in which to use this term are then discussed, as well as current and classic instructional development models. These instructional development models are analyzed and compared, and criteria for selecting a model for use in a specific project are given. Finally, a process for developing instructional development models is outlined, and areas of needed research are detailed. Six figures are provided. (68 references) (Author/EW)

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Chapter 8

State of ID Systems Approach Models

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An important aspect of the development of the theoretical foundations of educational technology is the application of General Systems Theory to the analysis of the various processes educational technologists engage in.

The present chapter reviews recent instances of this analysis, and then discusses the process of analysis itself.

INTRODUCTION

The author's purpose in writing this chapter is to present to the reader a review of the current state of instructional development systems approach models. Systems approaches abound in education today, and especially in the field of instructional development. Such approaches vary from the simple to the complex, and may or may not be accompanied by graphic representations or models to explain the process. But what is this process? Why are models necessary, or even desirable? What relationship does this process or these models have to instructional development? It is hoped that this chapter will help answer these and other possible questions about systems approach models as applied to instructional development.

WHAT IS A SYSTEM?

Before looking specifically at ID systems approach models the authors have chosen to present, some basic concepts and definitions that form the backbone of such models must be examined. The most obvious place to start is with a definition of a "system" itself. Numerous definitions exist, but Heinich's definition of a system as "a process which synthesizes and interrelates the components of a process within a conceptual framework, insuring continuous, orderly, and effective progress toward a stated goal" (AECT, 1979) seems to be a relatively simple yet comprehensive definition. The universe is the most typical example used to illustrate a system, with the various galaxies being components of the universe. By analyzing the interrelationships of the parts (in this case the galaxies), the whole (the universe) can be better understood and dealt with. However, as one looks at these relationships and parts, it soon becomes obvious that these parts themselves consist of parts, which in turn also consist of other parts, etc. This identifies the concepts of suprasystem (or the larger, all-encompassing environment), system (an identified part of the larger environment), and subsystems (or the smaller, component parts of the system). It is possible also to carry such identification further to supra-supra-systems, sub-subsystems, etc., depending upon how far the division is taken--and also upon the vantage point from which the identifications are first made.

An educational example of this suprasystem, system, subsystem concept can be seen with the identification of a school district as the suprasystem, the school itself as the system, and a single classroom within the school as a subsystem.

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Once again, one's vantage point is important and must be identified; the suprasystem might have been the state department of education, or even education at the national level; or the classroom might have been defined as the system and units of instruction as the subsystems.

OTHER SYSTEMS THEORY CONCEPTS

Other basic "general systems theory" concepts can also be of assistance in understanding the systems approach. Depending upon how freely the system can exchange information and energy with its environment a system may be termed as open or closed. An open system permits fairly free transmission of information or energy across its boundaries; whereas a closed system restricts the amount of information and energy that goes in and out. An adaptive system is one that is capable of making modifications to its structure so as to permit a more advantageous relationship with its environment. The classroom mentioned previously would be viewed as a closed system if it attempted to be entirely self-contained, relying upon resources within the classroom and excluding most other resources available within the system. However, if this classroom should decide to adapt to new conditions and requirements, to take advantage of external sources and experiences available to it, and to consider new ideas and innovations, it would become an open system.

All systems must have definable goals, with suggestions as to how these goals will be reached. In education, these suggestions take the form of measurable objectives, usually called behavioral or performance objectives. How effectively and efficiently these objectives are being met can be evaluated and the results given back to the originator of the system in the form of feedback so that necessasry adjustments can be made. This feedback is also used to continually monitor system activities.

One other general systems concept should be mentioned. The concept, equifinality, expresses the idea that the final end result or state may be reached in a variety of ways from a number of different starting points. The systems approach analyzes alternative ways of reaching that important end result or state (or goal) to determine the most effective and efficient way of reaching it. By analyzing the effect of each step or activity upon the entire system and by using problem-solving techniques, the most appropriate method and solution may be determined.

SYSTEMS APPROACH

As alluded to above, a systems approach is a problem-solving process. As such it is a management tool that organizes decision-making systematically, allowing the user to examine and interrelate all aspects of a problem and to analyze the effects of one decision over another in solving that problem. In other words, rather than a hit-or-miss or off-the-cuff method of solving a particular problem, the systems approach uses a step-by-step procedure: (1) to analyze the problem, (2) to determine possible solutions or decisions regarding the problem, (3) to consider the ramifications of each of these solutions or decisions, and (4) to appropriately relate and analyze all of these considerations in order to reach a final solution/decision. It is, of course, essential to know what your final goals or objectives are, and the value that you place on the alternative ways of systematically reaching those goals.

The development of such a systematic procedure or process in education traces its roots back to the development of weapons systems in the military (Twelker, 1971) and to the widespread use of audiovisual materials in military and industrial training programs during World War II. The industrial influence also was felt through the increasing use of interconnected networks of complex machines, which led to automation--and the heart of automation was the system. Automation also touched education and instruction, as television, language laboratories, teaching machines, and programmed learning were introduced. "About 1960, the phrase 'total systems approach' came to be used to describe the interaction of men and machines within the context of an organization in terms of specific tasks and outcomes" (Saettler, 1968). Title III of the National Defense Education Act (1958), Ford Foundation grants, and technological advances in computers also influenced innovations in instruction, as did additional developments of hardware and corresponding software.

There has been concern expressed in the last few years (Bratton, 1977; Sherman, 1978; Chadwick, 1979) that some users of the systems approach are caught up in the "systematic" aspect of the systems approach and have tended to lose sight of the wholistic view. As pointed out by Sherman (1978), "...the whole is seen as greater than the sum of its parts. The systems approach deals with the whole; the individual parts or components are important only as they relate to the whole." In addition, Chadwick (1979) points out that systems approach is "a point of view and therefore one must look at a system not only from the standpoint of its internal efficiency and functioning but, more importantly, one must find and study the relations of the system with all of the other systems in its environment." Bratton (1977) is one who suggests a movement away from the systematic approach toward a systemic approach in ID by giving the example of changes in the two editions of Kemp's Instructional Design. Bratton points out that "in the first edition, a procedural ID model is presented; in the second edition, a systemic ID model is described." (Bratton, 1977). These differences can be seen in the two models illustrated in Bratton's article, and reproduced as Figures 8-1 and 8-2 below:

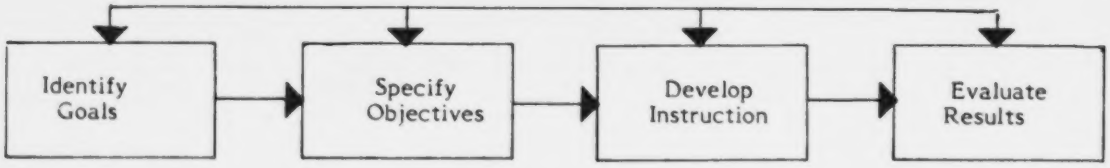


Figure 8-1. The systematic (Bratton, 1977, p.60).

Figure 8-2. The systemic (Bratton, 1977, p.60).

Concern has also been expressed (Arnn and Strickland, 1975; Harmon, 1979) for the human aspect of the systems approach. Harmon suggests a more holistic model for human performance analysis, and Arnn and Strickland discuss the critical element in the success of any systems approach as being the involvement of the participants. Since Arnn and Strickland are concerned with the "human system," which they feel exists any time two or more people interact, they question the apparent emphases taken in a "typical systems approach" within the following areas: (1) Problem vs. people, (2) Product vs. process, (3) Objectives vs. obstacle orientation, and (4) External vs. internal direction. After discussing some of their biases and assumptions concerning these emphases, they remind the reader that they are placing a higher priority on the people who comprise the system than on the system itself, and that "it is the effectiveness of the participation of the people which determines the effectiveness of the system." The individual steps that they then suggest for their human systems model are: 1) Initiate interaction, 2) Identify goals, 3) Identify obstacles, 4) Develop and implement strategies, and 5) Evaluate and modify.

MODELS

We have mentioned the term "model" a number of times, and it is appropriate to clarify that term. Various authors in the literature (Mauch, 1962; Black, 1973; Smith and Murray, 1975; Lowther and Saltinski, 1975) suggest that the term may be used in any one of the following four ways: 1) scale models--a scaled-down version of some original object, especially such as an airplane, train, city, etc.; 2) analogue models--in which an isomorphic relationship exists between the model and the original entity; 3) exemplar models--a type of design or conception of things worthy of imitation, such as a model "program", a model "curriculum", etc.; and 4) theoretical models--models with explanatory and/or predictive features used to solve a particular problem. Smith and Murray (1975) suggest that the third definition above is the one that is typically used in educational development and evaluation; that is, that development and evaluation models are simply designs of exemplary processes or procedures. Most of the models here also fall into this category.

EDUCATIONAL TECHNOLOGY/INSTRUCTIONAL TECHNOLOGY/INSTRUCTIONAL DEVELOPMENT

Before proceeding to a more detailed discussion of models of the instructional development systems approach, there is one more area in which some definitions are appropriate. The terms "educational technology," "instructional technology," and "instructional development" all are used at various points in discussing different models of the educational systems approach. These terms are often used synonymously or interchangeably, but for our purposes we are assuming the acceptance of AECT's definitions for these terms. Thus, **educational technology** is

> ...a complex, integrated process, involving people, procedures, ideas, devices and organization, for analyzing problems, and devising, implementing, evaluating and managing solutions to those problems, involved in all aspects of human learning. (AECT, 1979)

Instructional technology, as a sub-set of educational technology,

> ...a complex, integrated process involving people, procedures, ideas, devices, and organization, for analyzing problems, and devising, implementing, evaluating and manag-

> ing solutions to those problems, in situations in which **learning is purposive and controlled.** (AECT, 1979)

and finally, **instructional development** is defined by AECT as

> ...a systematic approach to the design, production, evaluation and utilization of complete systems of instruction, including all appropriate components and a management pattern for using them. (AECT, 1979)

The latter two definitions are depected graphically in the Domain of Instructional Technology Model (Figure 8-3) below:

Thus, we are using the process-oriented definition of instructional development rather than the prod uct-oriented meaning that has been used by some in discussing the topic. These definitions, along with the other definitions and concepts thus far presented, provide the context for the main topic of this chapter: models of the instructional development systems approach.

ID SYSTEMS APPROACH MODELS

There is certainly an abundance of instructional development systems approach models in existence today. All one has to do is flip through the pages of the various journals within the field (especially Educational Technology, for example) to find graphic illustrations and descriptions of new models. Such models may cover instructional development as a whole, or specific aspects within the overall process. Oftentimes these new models are a synthesis of previous models (i.e., Stamas, 1972; Knirk and Gentry, 1971; Twelker, 1972; Felker and Shettel, 1975), or are the application of a model to a particular type of instructional method or strategy (i.e., individualized instruction, competency-based instruction, computer-based instruction, games and simulations, etc.) or to particular fields of study within education (i.e., teacher education, vocational education, etc.). As one reviews the literature it becomes obvious that "THE" model for instructional development probably has not been (and may never be) written, or at least agreed upon, by a majority of people in the field. The basic reasons for this seem to be the same reasons why new models continue to be created--each person sees her/his situation as just enough different from other situations, or the desired emphasis as just enough different, that it seems to be necessary to revise or adapt an existing model, or to create a new one, to fit those situations and emphases.

Most of the overall instructional development models reviewed, (those covering the entire process) despite differences in terminology, cover the four basic components of:

1. Definition
2. Development (which includes design)
3. Evaluation (assessment)
4. Revision/Implementation,

with some type of feedback loop connecting at least two if not all of the components. Twelker (1972) and Durzo, Diamond & Doughty (1979) graphically depicted these elements as in Figure 8-4:

Within these four components, many, if not all, of the following activities take place (although not always in the order listed here):

1. Assess needs
2. Identify and/or analyze problems
3. Define settings
4. Determine goals
5. Specify behavioral objectives
6. Analyze tasks
7. Analyze resources
8. Select design formats
9. Select methods/strategies/materials
10. Organize management
11. Develop prototypes

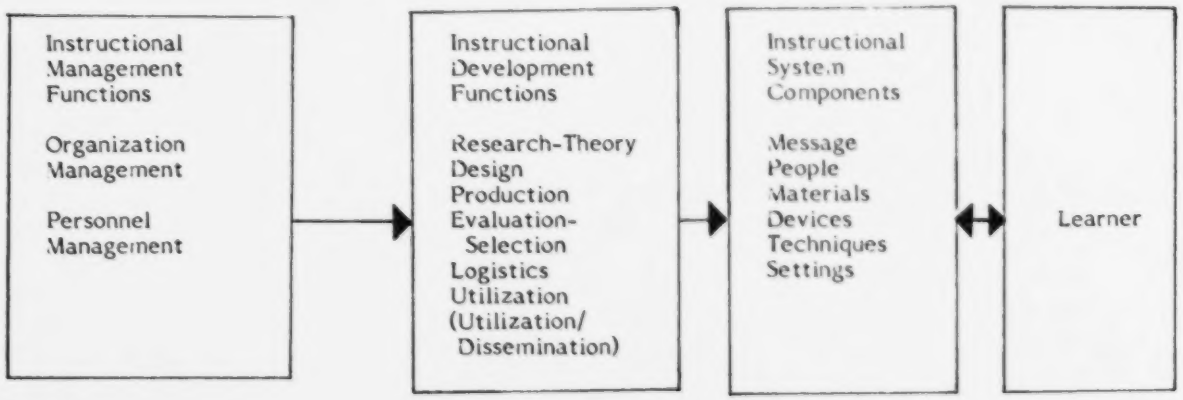


Figure 8-3. The domain of instructional technology model (AECT, 1979, p.12).

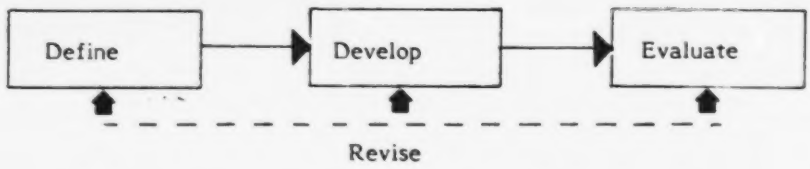


Figure 8-4. Systematic approach to instruction (a simple model).

12. Try out prototypes
13. Analyze tryout results (evaluate)
14. Modify or revise, as necessary
15. Recycle or implement

Resnick (1972) sees the four basic components as answering the following four questions:

1. Where are we now?
2. Where are we going?
3. How shall we get there?
4. How will we know when we have arrived?

"...Where are we now? deals with the assessment of a current educational system and an analysis of its existing resources, personnel, facilities, and program...Where are we going? relates to the establishment of goals and objectives...How shall we get there? is essentially a management issue...and How will we know when we have arrived? deals with the evaluation of the system." He graphically depicts his model as in Figure 8-5:

The evaluation component suggested above is comprised of four categories: 1) Effectiveness (essentially an evaluation of the student, or product evaluation; 2) Efficiency (consisting of two factors: a. cost-effectiveness, and b. time criteria); 3) Affectiveness (essentially a process evaluation as opposed to a product evaluation, dealing with the attitudes and values of the student); and 4) Relevancy. Since it is a goal-referenced model, he sees "the key criterion by which the effectiveness or adequacy of the performance of a system should be evaluated is how closely the output of the system satisfies the purpose for which it exists."

Several other authors (Tuckman and Edwards, 1971; Romiszowski, 1973; Jonassen, 1978) suggest that the common components of the systems approach be labeled: 1) **Analysis** (defining the purposes and parameters of the system, determining learning goals and instructional objectives, analyzing and describing learner tasks to be performed, and constructing criterion tests)--(Jonassen, 1978); 2) **Synthesis** (specifying instructional strategies and procedures, designing evaluation procedures, and constructing a trial solution); and 3) **Operation** (implementing the instructional activities and collecting evaluation data). The data collected during the evaluation portion of the operation phase is analyzed and fed back into the system for any necessary revisions (or further analysis and synthesis, and then further evaluation, until an optimal solution is developed). Each of the authors then presents a breakdown of these three phases into the various steps that they see as part of the process, with accompanying flowcharts.

Lippert and Drucker (1973) describe a technique, using simple index cards, which they call Lippert Cards, to facilitate the process of analysis and synthesis of tasks. This technique, similar to a nominal group process, allows for the flexibility of re-grouping tasks and sub-tasks without rewriting entire lists or redrawing suggested diagrams.

Silvern (1980) uses somewhat different definitions of analysis and synthesis as he combines them with modeling and simulation to form a systems engineering process called anasynthesis. Although he developed this process almost 20 years

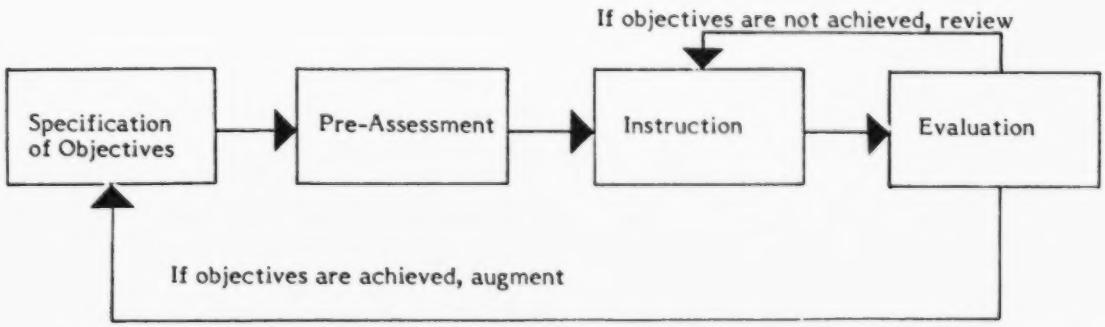


Figure 8-5. Resnick's model (Resnick, 1972, p.156).

ago and has applied it to decision-making and problem-solving in the education and training fields, he feels that "only highly innovative and imaginative educators embrace it." He later states that "it is a rather complex and rigorous process of mental gymnastics, involving a dedicated handful of highly motivated educators; for these reasons, it is not widely thought by educators in the U.S. to be of great worth." The general process of anasynthesis consists of these four parts:

1. Analysis is performed on existing information to identify the problem, identify existing elements, and identify relationships of these elements;
2. Synthesis is performed to combine previously unrelated elements and relationships into a new whole;
3. Modeling is conducted; models, usually in flowchart format, are constructed on paper to predict effectiveness without actual implementation of the system;
4. Simulation is performed using the models, which reveal alternative solutions. (Silvern, 1980).

Although many of the models of the ID systems approach deal with the overall instructional development process, a number of the models deal with specific aspects within that process. The following section deals with some of these aspects, and some of the models that describe each particular aspect.

INSTRUCTION/TEACHING/LEARNING

In the continuous attempt to improve the instruction/teaching/learning situation a number of authors have set forth various systems or models. For example, Lavi (1975) suggests a design for a Dynamic Learning System (DLS), in which dynamic learning is defined as "an efficient, active process wherein the learner participates, investigates, and inquires"; [an approach which the author feels is] "responsive to man's needs (and society's demands) throughout his life span." Further, it is suggested that the system is an "approach" and not an end in itself, and that it is "dynamic in the sense of active participation and is open to redefinition, updating and change from outside sources and through a process of re-evaluation.

Thiagarajan (1974) descibes an ID model of interactive teaching; a model which "incorporates many principles of instructional development, yet retains the element of face-to-face teaching." After showing the model and describing the steps, he states that he has taught this model to a number of in-service teachers and, in the process, used the model himself, and that all agree that it works. His final statements are that "compared to concentrated instructional development, this process is slower. But the results are surer and we do not have to stop the world of the classroom while developing instruction."

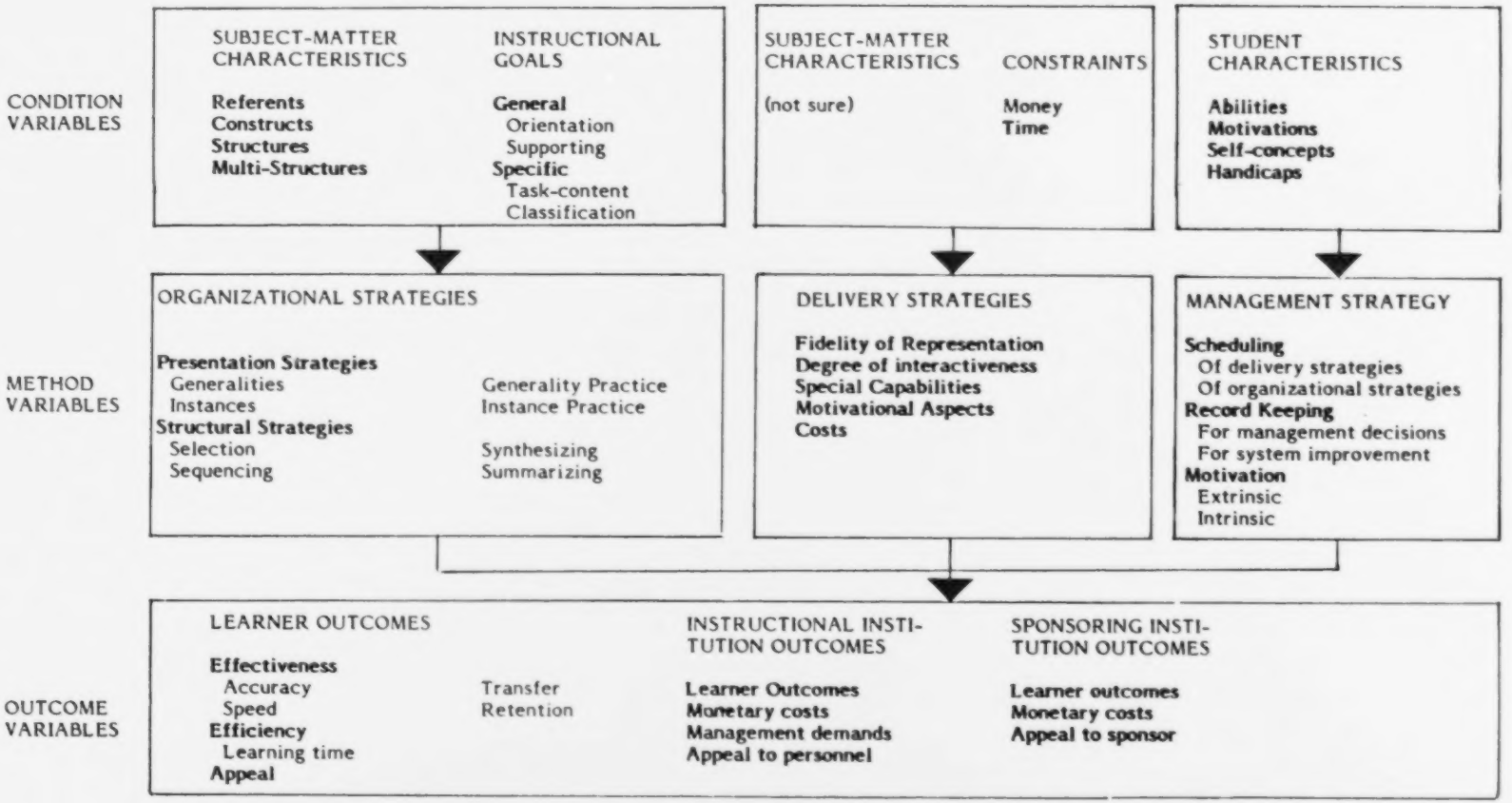
Finch (1973) focuses upon "the establishment of an instructional model which is based upon information provided by teachers. The model is intended to serve as a means for categorizing media in accordance with teachers' perceptions of the various media." Thus, rather than being a "provider"-based model it is a "user"-based one which establishes a generalized classification of instructional media.

A functional analysis of the classroom is made by Tosti (1968), who first describes general objectives of any operational system, and then the use of the PRIME (PRescription, Instruction, Motivation, Evaluation) model to conduct research on procedures which may better achieve objectives. The general system objectives which he describes are that the system must be: 1) Effective, 2) Efficient and economical, 3) Self-sustaining, and 4) Communicable. He then describes the prescriptive process, with its two phases (initial assessment and differential assignment) and its primary objective of directing "the learner through those materials necessary for him to achieve the desired objectives." His conclusion is that "the PRIME model has been successfully employed in the establishment of several operating classrooms...[and that] both the learners and the instructors like the way the system operates." In addition, impressive grade level gains have been made after 70 to 80 hours of instruction.

The perspective principles of instruction, especially as they provide a knowledge-base for the professions of instructional design and evaluation, are also a concern of Reigeluth and Merrill (1979). Since they feel that prescriptive principles of instruction describe cause-and-effect relationships among instructional variables, they are concerned that these instructional variables be clearly described and unambiguously labeled before being used to develop principles and theories of instruction. They describe these variables and classify them in the scheme illustrated in Figure 8-6.
They indicate their belief that these classes of variables should be considered when one is: 1) designing instructional materials, 2) doing research on instruction, or 3) developing better methods of instruction (theory-construction). Whereas some work has been done on postulating and testing such casual relationships, they contend that a majority of the necessary work remains to be done.

One attempt at developing a better method of instruction is Reigeluth's elaboration theory (Reigeluth, 1979). This theory deals primarily with macro strategies for organizing instruction (although it also includes many motivational strategies), as opposed to the standard way of organizing instruction based on a hierarchical task analysis. He uses an analogy of a zoom lens to describe the nature of his elaboration model, whereby a person starts with a wide-angle view showing major relationships and parts of a picture without any detail, then zooming in on a part of the picture. In this case, the zooming operates in steps or discrete levels, until the desired level of detail is reached. The author feels that if cognitive instruction is organized in this general-to-detailed way, "instruc-

Figure 8-6. (Reigeluth and Merrill, 1979, p.3).



tion will result in higher levels of learning, synthesis, retention, and affect," and that although the model and procedures "have undergone very limited field testing and virtually no research," there is great potential for the elaboration model to meet the need for alternative instructional design approaches.

MANAGEMENT

One of the important components of instructional development systems approaches is management, whether it be of the entire process itself, or of specific aspects within the process. Of the various models available covering the overall process, the management framework model proposed by Gentry (1977), as it applies to teacher education programs, is probably one of the more detailed models. The components of the model are grouped into cyclical components and supporting components, connected by a communications network, with a range of techniques suggested for operating these components.

Conkright (1979) suggests a three-dimensional model as a systems approach to managing complex educational projects. This model, consisting of program phases, program elements, and program controls, "provides a vehicle for analyzing project needs, for staffing project personnel, and for tracking project tasks to assure a unified, coordinated effort." Although the model is "still in its formative stage--still subject to the demands of multiple field tests...its validity and practical application are considered high within experienced Control Data management."

For those concerned with instructional accountability, Gorman (1979) suggests the Instructional Management Accountability Model (IMAM) as a possible approach. This model consists of "three essential interrelated elements; the instructional program, the supporting facility, and the involved staff. It can be applied to an unlimited number of instructional disciplines, programs, or areas."

Lowe and Schwenn (1975) also are concerned with a variety of educational settings, and especially how the instructional development process functions in such a variety. In order to attain greater generalizability of ID models, they suggest that descriptive data, with detailed accounts of how the ID process progresses and performs, is needed. Documentation, or the "coordinated activity of preserving proposed and developed plans of activity and collecting and recording detailed accounts of how these plans are realized," is the system they suggest to accomplish this task.

One subset of the management function of an instructional development project is the management of personnel. Stone (1975) suggests several alternative ways of organizing the personnel structures to be used in projects involving the preparation of multimedia instructional materials. These structures consist of: 1) the specialist approach (all steps performed by a single instructional technologist), 2) the chain approach (a variation of the specialist approach whereby overlaps or links are deliberately planned), 3) the interdisciplinary team approach (teams formed, composed of persons with different specializations), and 4) the matrix approach (in which the organization, in addition to the general management groups, is composed of two types of entities: functional groups and projects). The matrix approach aims at the efficient use of personnel, using a specialist only when needed by the project; functional personnel ensure that technical standards are followed; and a project manager deals with day-to-day problems and keeps the project moving toward its objectives.

Brien and Towle (1977) also are concerned with the amount of time, specialized manpower, and money that is often required in producing effective instructional systems, especially in highly specialized areas. They, too, suggest a team approach, but instead of the instructional devleopment team being composed of only two people (the instructional designer and the subject-matter expert), they suggest the addition of a "third man" to the team. This third member, who should possess a few skills in instructional design and who also should have some knowledge of the subject matter, but who is not expected to be an expert in either area, may "provide the bridge between instructional design activities and the subject matter to be taught." Such a procedure will decrease the requirement of the instructional designer to become acquainted with the subject matter and will reduce the costs involved with the subject-matter specialist. The procedure is carried out in the following way:

> For each step of the process in the design and development of an instructional system, the "third man" writes a draft which is reviewed and revised by both the subject-matter specialist and the instructional designer in order to determine if the "principles" in their fields have been respected. The tasks of the instructional designer and subject-matter specialist consist mainly of supervision and review of proposed instruction rather than the time-consuming creation of instruction. (Brien and Towle, 1977).

Techniques are then suggested for reducing the time for executing the steps in process.

Another subset of the management function in instructional development is the decision-making process, with various models outlining this process. For example, Ames, Linden, and Feldhusen (1977) describe a Guided Design systems approach, which "provides a means for giving careful guidance and feedback to small problem-solving groups." Used as a new approach to Stage Two of the Purdue Three-Stage Model for College Course Design, this approach: 1) replaced the basic, general problem-solving model with a series of instructional deci-

sion-making models; 2) divided Group Instruction guides into two sections so students could learn how to make and implement decisions; and 3) expanded the Group Feedback so that students could evaluate the worth of their own decisions and products, rather than just comparing them to the response of an "expert." Thus, "this system of instruction results in students who can solve educational problems using a decision-making process consistent with current instructional theory."

Decision-making is also discussed as a hier archical and sequential process involved in media selection (Tiffin and Combes, 1974), and as two procedures for facilitating the use of controversial instructional materials (Splaine, 1977). The latter two models are involved with: 1) decision-making for selecting controversial materials, and 2) the involvement of important groups and persons in selecting controversial materials.

NEEDS ASSESSMENT

Another important component of instructional development systems approaches that is not only one component of the entire process, but one which also yields many models in and of itself, is the topic of needs assessment. Essentially, needs assessment is a process for identifying and measur ing gaps between **what is** and **what ought to be**, prioritizing the gaps, and determining which of the gaps to work on to obtain closure. Some of the often-discussed and used models for needs assessment are Kaufman's "Needs Assessment" (1975), Coffing's "Client Need Assessment" (1977), Lee's "Needs Assessment Model" (1973), and Harless' "Front-End Analysis" (1975) models. (See Trimby, 1979 for an analysis and analytical matrix comparing these four models.) An instructional designer's role in needs assessment may vary anywhere from designing and conducting needs assessment studies, to assessing already-completed studies, to identifying which needs have the greatest potential impact, to simply utilizing a given list of instructional goals for which instructional materials and procedures are to be designed. (Dick and Carey, 1977). Therefore, Dick and Carey suggest procedures or steps the designer can employ in proceeding from needs assessment to systematically-designed instruction. These steps are based on four possible entry points for the designer: 1) needs assessment, 2) documented needs, 3) instructional needs, and 4) instruction. The steps involve a framework for summarizing findings, identifying study limitations, validating identified needs, differentiating between instructional and noninstructional needs, categorizing needs into clusters, selecting needs with the greatest potential for program impact, and converting prioritized lists of instructional needs into instructional goals. All of this is done while keeping in mind that special organizational considerations may affect the design and the implementation of instruction.

EVALUATION

Still another essential component of most instructional development system aproaches, and one which also has its own models, is evaluation. These include such models as the CIPP Model (Stufflebeam, 1968), the Countenance Model (Stake, 1967), the Discrepancy Model (Provus, 1971), and Scriven's Formative Evaluation Model (Scriven, 1972). Baker and Alkin (1973) give a review of the research pertinent to formative evaluation of instructional development, noting that at that time the research was relatively limited. Tennyson, in his model (1978) includes evaluation in every phase of development (the four phases are: assessment, design, production, and implementation), which he claims makes his model different from earlier instructional development models. (His model also differs from earlier models in that he gets away from the flowcharting idea; he states, "The instructional development model described in this paper was deliberately constructed to eliminate the boxes and arrows commonly used to illustrate how development works." The four types of evaluations matched with the four phases of the model, are: 1) Assessment phase--feasibility evaluation; 2) Design phase--formative evaluation, 3) Production phase--summative evaluation; and 4) Implementation phase--maintenance evaluation.)

An evaluation system similar to a management-by-objectives system is suggested by Orlich (1979). "This system is designed for goal-directed activities and for those who desire to use evaluation as one means by which to improve any educational efforts and behaviors." He utilizes a planning/evaluation grid, contingent upon the availability of three components: "1) a concept or practice which is to be assessed, evaluated, or judged; 2) a series of selected variables or key descriptions pertaining to the concept; and 3) a discrete series of evaluative criteria which form a logical gradation or continuum, one of which will be selected as the best fit for the current or anticipated condition within any specified program or project," Orlich suggests that anyone could make her/his own appropriate grid.

INDIVIDUALIZED INSTRUCTION/ COMPUTER-BASED INSTRUCTION

One of the instructional methods or strategies covered by a number of instructional development models is individualized instrucion. Francis Atkinson (1976) describes one such systems approach, to be used in designing original mediated instructional materials/activities or adapting existing materials/activities for individualized instruction. Practical guidelines are given in a nine-step model, along with six implementation considerations recommended for preparing for the teacher and four suggestions for preparing the student.

Joel Davis' three step model (1977) for the design and implementation of an individualized

instruction program is an adaptation of Tuckman and Edwards' model (1971), mentioned earlier. The three activities involved in this case are analysis, synthesis, and operation; operation is a procedure to be used for determining an optimal individualized instructional program.

Consequences of the implementation of several commercially-developed individualization systems with respect to teacher beliefs and practices and to pupil attitudes and achievement are described in a report by Bosco, Harring, and Bandy (1976). The five systems included in the study reported by Bosco, et al., are: Alpha II, READ, PLAN, Learning Unlimited and McGraw-Hill Programmed Reading. These five management systems appear to produce an impact upon teacher's beliefs and practices, with less evidence of impact upon student achievement and attitude. Descriptions of other systems approaches to individualized learning, such as U-SAIL (Utah System Approach to Individualized Learning) and ACIL (Arizona Consortium for Individualized Learning) are described by Robinson (1975) and Webb and Howard (1977), respectively. The PRIME model (Tosti, 1968) has already been described in this paper in some detail.

Since some of the above programs have met with promising success, Spuck and Owen (1976) suggest that computer-based management information systems are essential to the effective implementation and operation of such programs. Their article considers "the structural components essential to programs of individualized instruction, leading to a model of a generalized computer-managed instruction (CMI) system. Lastly, extension of the CMI model which suggest applications in the evaluation of the instructional program are discussed."

Another example of utilizing the computer for instructional purposes is the adaptive model for utilizing data on learner characteristics in computer-based instructional systems, suggested by McCombs, Eschenbrenner, and O'Neil (1973). Since they feel that the affective or motivational component has not been explicitly included in most systems models, they have included this, along with cognitive learner variables, in their model for designing computer-based instructional materials.

SIMULATION/GAMING

Another instructional method or strategy in which systems approaches have been used in the design process is simulation/gaming. Atkinson (1977) describes such a systems approach, the first five steps of which are similar to the process used when planning most instructional activities. "By following these initial steps the designer will be able to determine the appropriateness of using simulation/gaming activities to solve a clearly-defined instructional problem...The decision to design a simulation/gaming activity should be made only after a careful analysis of each of the first five steps of this systems model." The following seven steps are concerned with decisions which must be made in designing a simulation/gaming activity; the last five steps (for a total of 17 steps) are concerned with several other important decisions to be made and related materials to be developed.

Other authors concerned with the design of simulations/games have suggested models for such purposes as designing simulations for orienting new employees to their job situation (Stonewater, 1978); for decision-making (Easterly, 1978); and for designing and implementing the use of human simulators, not only in the medical field, but in other fields as well (Collart, 1979).

MODEL ANALYSIS AND SELECTION CRITERIA

With such a vast array of models in existence, covering not only the entire instructional development process, but specific aspects as well, how does one go about analyzing such models, and selecting one that is appropriate? Through an examination of a broad range of models, it is clear that their functions vary from model to model. Based upon that variance, criteria in the form of questions have been derived. Although not an exhaustive list, these criteria, listed below, should give the reader a good start in looking at and choosing a model. They may also convince readers of the need to synthesize a new model from existing ones in order to meet their special conditions.

1. **Audience being addressed.** Is the audience being addressed by the model stated, or merely inferred? How similar is it to the audience you are working with? Is it a sophisticated or more beginner-type audience?

2. **Particular emphasis desired/focus of model.** What is the emphasis of the model? How many functions are covered by the model? Does it cover an over-all process, or just some aspect of that process? Is it process-oriented, or product-oriented? Which orientation is most appropriate for your particular situation?

3. **Structure of model/linear or non-linear.** Is the model so structured that it is a step-by-step approach that must be followed exactly? Or is it more flexible, allowing entry at a number of points (or at any point)? Is it possible to re-cycle to an earlier point, if necessary? Is there information flow between and among the steps (feedback)? Is there a flowchart of the over-all process, as well as narrative description of each of the steps, so that the model can be fully understood?

4. **Relationship of developer to client.** What is the relationship of the developer to the client? Is the client continually involved in the process? (which may require additional interpersonal skills on both parts), or does the developer have "free reign" for the design and development? Must each step in the process be approved by the client?

5. **Individual or team oriented (Who is responsible for development).** How many people will be involved in the development process? Is it strictly a one-person type process, or will a team

of developers be necessary? Where do subject-matter experts enter the picture? (If at all--or is the developer expected to be a subject-matter expert, as well?) As above, must each step be checked and approved by the client, or may the developer(s) proceed as necessary?

6. **Potential for implementing.** What is the potential for implementing a certain model in your particular situation? Is the model in question such a drastic change from your current situation that a large-scale "diffusion of an innovation" process would have to be undertaken? Would certain steps in the model pose problems for certain people within your organization, or within the general political structure of your organization? Would the implementation require additional funding that might be very difficult to obtain? Would those involved see it as an improvement over current practices? (And more importantly, would it really be an improvement?)

7. **Life expectancy of project/process.** What is the life expectancy of a particular project or process for which the model is being considered? Is it really worth the extra time, cost, efforts, etc. to adopt the model, expecially if for a short-term project? Or, is it a process that, once established, could potentially be used for a long time in the future?

8. **Cost effectiveness/efficiency.** Is there some way (either provided, or that you can determine) to analyze the cost effectiveness/efficiency of the model in question? (I.e., as compared to your current situation, or compared to other models that you might also be considering?)

9. **Research support.** Is there research support for the model, or is it just someone's "good idea" that looks as though it would work, but hasn't been tested? Is someone just "re-inventing the wheel?" or is the model new and different and a worthwhile change?

PROCESSES COMMONLY USED TO DEVELOP SYSTEMS MODELS

Application of the criteria presented in the preceeding section indicates why new models are constantly being derived. Listed below are some of the processes commonly used to develop systems models.

Adaptation/Modification of an Existing Model

As has been mentioned previously, one method for developing a systems model is to adapt or modify an existing model, especially in order to fit it to a particular situation. Depending upon the extent of revisions, adaptations, or modifications, or the way in which the model will be applied, the resulting model may be considered as a "new" model.

Synthesis of Existing Models

Another method that may be used to create or develop a new systems model is to combine or synthesize several existing models. In this case, certain aspects of each of the various models are viewed as being desirable, and are combined to form a new, synthesized model. As above, this is often done in order to fit a particular situation or an intended usage of a model.

Creation of a New Model

Probably the most difficult way to create a new model is to start from scratch and build a model. Dorfman (1960) suggests three aspects to model building, all of which are closely related, but each requiring different skills. These three aspects are: 1) straight-forward description (expressing the situation under study in terms of the symbolism adopted)...frequently through the use of block diagrams and relationship lines connecting the boxes; 2) creative hypothesizing (the introduction of the motivational, behavioral, and technological assumptions that will be used); and 3) quantification (the assignment of numerical values to the parameters of the model.) (Dorfman, 1960.)

Lowther and Saltinski (1975) suggest that models possess certain similarities, such as being an abstraction of reality and emphasizing structure, relationship and process. In addition, they suggest the following additional attributes of models:

1. **Input Provisions.** The point through which data, either quantitative or qualitative, enter into the model is clearly specified.
2. **Direction and/or Sequence of Information Flow.** The model specifies the path and direction for the flow of data through it. Some models have intermediate checkpoints at which the data can be examined before completing the journey.
3. **Interaction-Synthesis Sectors.** Models have points or locations at which the input may be transformed or synthesized as a result of some process or interaction with some components.
4. **Constraints.** Those limitations and/or barriers in a system which prevent either the flow of data, or activities from taking place under specified conditions, are frequently incorporated into models.
5. **Output Provisions.** As with input, models are characterized by incorporation of clearly designated points through which data, or information, leaves them.
6. **Self-Regulatory Mechanism.** Finally, many models incorporate some type of self-regulatory mechanism which facilitates the comparison of the output with the input and thus provides a basis for evaluating a system's effectiveness in relation to its goals or purposes, or its ability to provide solutions to problems. (Lowther and Saltinski, 1975.)

And finally, Rubinstein (1975), in a chapter on the

nature of models, in his book, Patterns of Problem Solving, suggests the following steps for the modeling process at an early stage:

1. Establish the purpose of the model.
2. List the possible elements (observations, measurements, ideas) which may relate to the purpose, however remote.
3. Select those elements of Step 2 which are relevant to the purpose in Step 1.
4. Aggregate elements which can be chunked together by virtue of the strong structural, functional, or interactive connections between them. This is a process of classification, in a sense.
5. Repeat Step 4 several times until a model consisting of seven, plus or minus two, chunks emerges. (Rubinstein, 1975.)

While there are many other authors (i.e., Beauchamp, 1968; Snelbecker, 1974) who have given suggestions about how to develop models, the ideas presented here will give a starting point for readers who wish to create their own systems approach models.

CONCLUSION

This chapter has attempted to present the current state of development of models of the instructional development systems approach. It began with basic definitions of such concepts as: system; interfaces; open, closed, and adaptive systems; goals; feedback; equifinality; and systems approach. The development of the systems approach concept was briefly traced, and some of the concerns regarding this approach was expressed.

Models, and four ways the term is used, were then discussed, and then related to models of the instructional development systems approach. Basic components of systems approaches, and the different ways they are interpreted by a number of different authors, were presented, both in terms of the overall process, and of specific aspects related to: instruction; teaching; learning; management; needs assessment; evaluation; individualized instruction; computer-based instruction; and simulation/gaming. A partial listing of criteria to use in analyzing and selecting a model were suggested, as well as procedures for developing models.

Research Needed

One thing that was noticed while reviewing the literature is that very few of the authors who present systems approach models mention any attempts at validating their models through research. Stamas, in an earlier study of systems approaches, pointed out the same fact:

> "Few instructional developers have attempted to apply a model to developmental problems for the purpose of reporting consistencies and discrepancies in the model. Of significance also, is the fact that few, if any, instructional developers have reported strategies for measuring the effectiveness of development resulting from the application of a model." (Stamas, 1972.)

In addition, he found little or no evidence to indicate that any models were revised after study. Studies by Stamas (1972), Massey (1975), and Stolovitch (1975) were attempts, however, to validate certain models.

Diamond (1980), in his article on some of the problems, issues, and the future of instructional development, also points out the lack of research in the area of procedures and models (as well as organization, administration, and developer-client interaction). In addition, he states that "Graduates from one institution have often understood fully only one model and have discounted all others."

Future of Systems Approach Models

Undoubtedly, systems approach models for instructional development will continue to be developed in the future, some being adaptions or modifications of existing models, some being synthesized models, and some being newly created models. "THE" instructional development model probably never will be (and possibly should not be) created. However, as new models are developed and field tested, we may come closer to "THE" model.

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